

of the dark lines relatively to the corresponding bright ones gave a mean of 18.3 tenth-metres. According to this, the relative motion of the two bodies engaged was about 820 miles a second. Mr. Maunder also observed the visual spectrum of the Nova. Three bright lines were seen, and estimated to be in the positions of C, D, and F of the solar spectrum. A line was detected "not far from E," another "near δ , but further towards the blue," and another "very near the chief nebular line." The line measured on the photograph as at λ 4919 was also made out.

PHOTOGRAPHS OF THE REGION OF NOVA CYGNI.—At the March meeting of the Royal Astronomical Society, Mr. Roberts stated the results of a comparison of Drs. Copeland and Lohse's catalogue and chart of the region of Nova Cygni with two photographs of the same part of the heavens taken in September 1891. It appears that the brightness of some of the stars has undergone changes since 1878, when the chart was made. Changes of this character may, of course, be due to the well-known difference between visual and photographic magnitudes; but there are other differences, which are not so easily explained. Several stars, single on the chart, are seen to be double on the photographs, and some changes in relative position seem to have occurred. Although the Nova is not given on the chart, it appears on the photographs as a star of about magnitude 13. It will be interesting to compare Mr. Roberts's pictures with others taken under similar conditions at some future date, in order to determine definitely whether the changes are real, or due to errors in observation or cataloguing.

WINNECKE'S COMET.—Dr. G. F. Haerdit gives the following ephemeris in *Astronomische Nachrichten*, No. 3083:—

1892.	R.A.		Decl.	Brightness.
	h.	m.	s.	
April 29 ...	11	36	4'49 ...	+43 55 41'3
" 30 ...		34	22'64 ...	44 2 13'6
May 1 ...		32	42'41 ...	8 8'3 ... 2'38
" 2 ...		31	3'89 ...	13 25'6
" 3 ...		29	27'21 ...	18 6'3
" 4 ...		27	52'46 ...	22 11'9
" 5 ...		26	19'62 ...	25 43'4 ... 2'71
" 6 ...		24	48'66 ...	28 42'1
" 7 ...		23	10'55 ...	31 8'6
" 8 ...		21	52'27 ...	33 3'6
" 9 ...		20	26'81 ...	34 28'1 ... 3'10
" 10 ...		19	3'16 ...	35 23'3
" 11 ...		17	41'31 ...	35 50'0
" 12 ...		16	21'18 ...	35 49'6
" 13 ...		15	2'62 ...	35 22'5 ... 3'58
" 14 ...		13	45'59 ...	34 29'4
" 15 ...		12	29'98 ...	33 11'2
" 16 ...		11	15'72 ...	31 28'7
" 17 ...		10	2'63 ...	29 22'9 ... 4'17
" 18 ...		8	50'51 ...	26 55'0
" 19 ...		7	39'29 ...	24 5'2
" 20 ...		6	28'92 ...	20 53'7
" 21 ...		5	10'08 ...	17 21'4 ... 4'91
" 22 ...		4	9'48 ...	13 29'0
" 23 ...		2	59'99 ...	9 17'4
" 24 ...		1	50'50 ...	4 47'8
" 25 ...	11	0	40'59 ...	44 0 0'3 ... 5'84
" 26 ...	10	59	29'91 ...	43 54 55'3
" 27 ...		58	18'15 ...	49 33'4
" 28 ...		57	5'05 ...	43 55'1
" 29 ...		55	50'13 ...	38 0'7 ... 7'04
" 30 ...		54	33'03 ...	31 50'9
" 31 ...		53	13'21 ...	25 25'2

PERSONAL EQUATIONS IN TRANSIT OBSERVATIONS.—An accurate determination of an observer's personal equation is to-day of as much importance as an observation itself, when such small quantities, as we now deal with, have to be measured. The variation in the latitude, of which we have heard so much of late, amounts to a quantity only a few times larger than that of a moderate personal equation, showing that no small regard must be paid to its estimation. In observing an N.P.D., the star has to be bisected by the horizontal wire, while the nadir point has also to be observed: in both these cases an error can arise from personality, for the best observers cannot make a really true bisection. In the taking of transits another personality exists, but this is rather of a different kind, for, using the eye

and ear method, the clock beats have to be taken into account simultaneously with the relative positions of the star and certain wires. In the April number of the *Bulletin Astronomique*, an account is given of some experimental researches on such transit determinations in which both methods, the eye and ear and the chronograph, were used. The observations were made with an apparatus similar to that designed by Wolf, who, to obtain artificial transits, employed a small truck to carry the plates, on which punctures of different sizes were made. From 115 observations made with both methods, it was found that equally accurate results were obtained, the eye and ear method, if any, proving a little inferior, while the degree of lighting of the field made no appreciable variation on the personal equation. For planets the electrical method showed that personality varied considerably, according to whether the preceding or following side was observed: the resulting personal equation for the centre of a planet turned out to be $-0.046s$, while that for a star under the same conditions was $+0.023s$. It would be interesting to find out whether this occurs when the eye and ear method is employed. The tendency of an observer, adopting the eye and ear method, to choose certain tenths of a second in preference to others, seems to have its analogy in the chronograph method, in the linear measurement from the second impressions. A comparison given here shows that the most favourable tenth is the *zero*, while the *nine* is very considerably left out in the cold. Another very curious fact is that the tenths, one, two, three, four, chosen in the chronograph methods, are all *less* than the corresponding ones in the other methods, while the opposite occurs for the tenths five to nine.

Tenths	0	1	2	3	4	5	6	7	8	9	Total
Eye and Ear . .	157	97	134	134	100	94	82	81	74	57	1000
Chronograph . .	164	79	96	90	94	129	104	94	81	69	1000

THE SIRIUS SYSTEM.—Dr. A. Auwers contributes to the *Astronomische Nachrichten*, Nos. 3084 and 3085, a long discussion with reference to our "Knowledge of the Sirius System." The problem which he undertook was to investigate whether the measures of the companion obtained during the period extending from 1862 to 1890 would satisfy an ellipse with a 49.4 year revolution; to determine the most probable value of the place elements for every measurement on the assumption of the revolution; and to inquire whether the observations of the principal star could be represented by means of the so determined elements. The author divides the discussion into the following three parts:—(1) A summation and sifting of all the measures that have been made of this companion for the above-mentioned period. (2) The derivation of the normal places, and the correction of the elements. (3) A comparison of the meridian observations of Sirius with the elements derived from the measurements of the companion. The result of the discussion is that a slight correction is necessary to reduce the right ascension and declination of the bright star to the centre of gravity of the two bodies (the masses of the chief star and of the companion being taken as $2.20\odot$ and $1.04\odot$). The table showing these corrections indicates that the right ascension between the years 1850 and 1890 has to be increased by a quantity which reaches to $0.232s$, while between 1890 and 1896.5 a diminution takes place. The greatest correction for the declination is $+2''268$, which occurs in 1882.0, and this correction becomes negative also about 1893.5.

THE ANCIENT CIVILIZATION OF CENTRAL AMERICA.

IN Central America there are abundant traces of the existence of a great race which must at one time have attained to a comparatively high state of culture. It was undoubtedly a race of American Indians, and as undoubtedly closely connected with the present Indian inhabitants of the country.

No trace, however, of the ancient culture and knowledge can be found amongst the Indians of to-day, and the numerous ruins which lie scattered over the country are the remains of towns which have neither names nor history attached to them.

Very little information can be gathered from the published writings of the Spaniards who overran the country at the close of the fifteenth and beginning of the sixteenth centuries; but, apart from their bearings on Spanish history and biography, these writings have received very imperfect examination and criticism.

The Spaniards have been severely censured for their remiss-

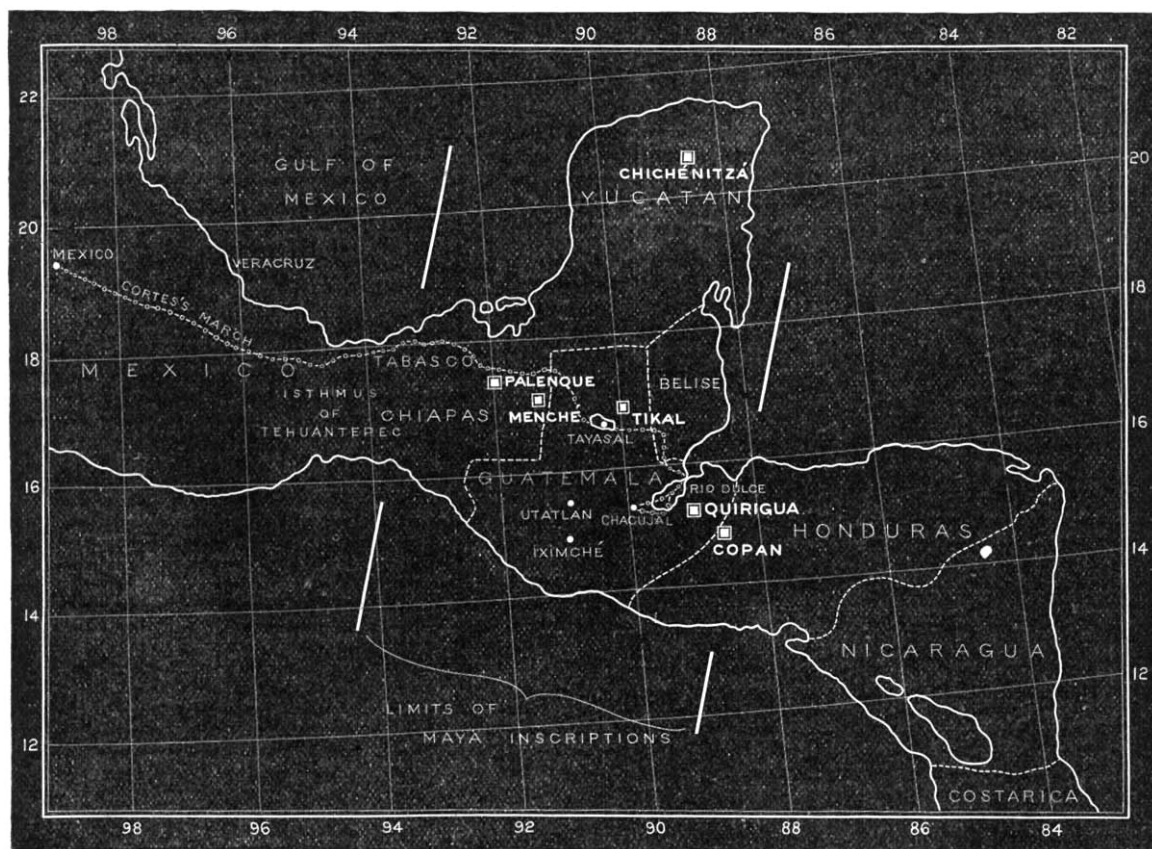
ness in omitting to record the wonders of the Indian civilization which they are supposed to have met with, and especially for having failed to tell us about the towns and highly decorated buildings the ruins of which have been frequently described by modern travellers; but this censure appears to be to a great extent unmerited, for their writings, if carefully searched, do reveal a considerable amount of information about the Indians as they found them, and they failed to describe the ancient buildings because, as I hope to prove later, in many cases these buildings were even then as deeply buried in the recesses of the forests as they are at the present day.

We naturally want to know more about this lost civilization, and there are many ways of attacking the problem. First of all, there is a large amount of correspondence, and a great number of reports written by the soldiers, officials, ecclesiastics, and other early settlers in the New World, which, not bearing on the main historical events of the conquest, have escaped publication, but which, if carefully examined, may afford valu-

well as some original stone carvings, are now exhibited in the Architectural Court of the Museum. Maps, plans, photographs, and drawings, are in course of publication in the archæologia section of the "Biologia Centrali-Americana."

The Editor of this journal has asked me to give some general account of the work on which I have been engaged, and its results, and this I will now attempt to do; but I must ask the reader to bear in mind that I started on the work almost by chance, and without any previous training or archæological knowledge, that I am but little acquainted with the literature of the subject, and have almost entirely confined my efforts to the collection of accurate copies of sculptures and inscriptions, in hope that some students may be found willing to make use of them. The following notes must therefore not be looked on as anything more than an attempt to clear the ground before an attack which I hope some day to see made on a difficult problem.

The remains of the more civilized races of North America



able information regarding the native Indians. Then a study of the customs, languages, and folk-lore of the living races, may throw much light upon the condition and belief of their fore-runners; and, above all, a careful examination of the burial-places and of the architectural and monumental remains, and their numerous hieroglyphic inscriptions, which lie hidden away in the vast forests, may reveal something of the history of the people who raised them.

It has been my good fortune to be able to devote my time during seven winters to the collection of materials which I trust may enable the study of Central American archæology to be pursued with greater ease and success than has hitherto been possible.

All the moulds of inscriptions and other sculptures made during my expeditions have been handed over by me to the authorities of the South Kensington Museum, and casts have already been taken from the greater number of them, which, as

can be traced from the Isthmus of Panama as far north as the ruined Pueblos in the Cañons of Colorado. This great extent of country can again be roughly divided into three portions—one extending from Colorado to the Isthmus of Tehuantepec, a second from Tehuantepec to a line running nearly along the western frontiers of Honduras and Salvador, which may be called the Maya district, and a third from this line to the Isthmus of Panama.

So far as I know, no remains of stone buildings have been found in this last district, but much pottery is found—some of which is distinguished by great beauty of form, as well as excellence of decoration.

It is in the centre province, which includes Guatemala, Chiapas, Tabasco, and Yucatan, that my collections have been made, and the accompanying map shows the most important ruins visited.

It is impossible within the compass of an article, and

without the aid of numerous plans and drawings, to give an adequate account of the ruins as they can now be seen, but the following short summary gives the characteristics of the principal groups found to the south of Yucatan:—

Quirigua.—Thirteen monoliths covered with elaborate carved decoration and inscriptions. These are of two classes, upright stelæ, of which six still stand erect, the tallest measuring 25 feet high from the ground, 5 feet across back and front, and 4 feet across the sides, and large rounded blocks of stone cut into the form of some grotesque animal, the largest of them weighing about 20 tons. No buildings remain standing, but there are numerous mounds, only one of which has been dug into, and was found to contain on its summit the ground-work of a stone-built temple.

Copan.—Sixteen stelæ averaging 12 feet in height, of which eight are now standing, and numerous other sculptured monuments. Both figures and inscriptions are carved in higher relief than at Quirigua. Numerous stone-faced mounds, which can be ascended by well-laid stone stairways. There is no sign of a wall either of house or temple above ground, but the lower parts of both temples and houses can be found by digging into the masses of broken masonry on the tops of the mounds and terraces. Broken stone ornaments, which once decorated these buildings, are found lying in profusion at the foot of the mounds.

Menché.—A town built on stone-faced terraces rising one above the other from the banks of the River Usumacinta. There are many mounds of stone, and there are a few stone-roofed houses and temples still standing with carved stone lintels over the doorways. No separate carved monolithic monuments of importance.

Tikal.—Five cell-like temples with enormously thick walls, raised on pyramidal foundations of great height. The measurement of the largest, from the ground to the top of the temple, is about 160 ft., the base of the foundation measuring about 280 ft. square. These temples had beautifully carved wooden lintels over the doorways. Some of this carved wood is now preserved in the Museum at Basle, and some (a few smaller pieces) in the British Museum. There are several other smaller temples and numerous houses with stone roofs still standing. All these buildings had wooden lintels over the doorways, and some of the wooden beams are in a perfect state of preservation. There are seven or eight small stelæ, usually flat slabs of stone with carving on the front and sides only, all unfortunately much damaged and weather-worn.

Palenque.—One group of stone-roofed houses, commonly known as the palace, raised on a high stone-faced foundation. Four separate temples on similar foundations, and numerous other temples, houses, and tombs, some half-ruined, and others mere heaps of stone and rubbish. Only one carved monolith has been found which stood apart, but several large stone slabs beautifully carved with figures and inscriptions in low relief were let into the interior walls of the temples, and almost all the buildings have been lavishly ornamented with figures and inscriptions moulded in a hard and durable stucco.

The principal fact ascertained from the examination of the remains throughout this district (including Yucatan) is that the art as exemplified both by monuments and buildings is one and the same, and that the inscriptions are all carved in the same characters.

The chief difference to be noted is that whereas in the ruins which I assume to be of earlier date the art and workmanship is lavished on the decoration of large monoliths, whilst the temples and other buildings are comparatively insignificant, as time went on the elaborate carving of separate stone monuments was neglected, and the whole efforts of the artists were devoted to the erection and adornment of larger and more imposing buildings, and the carved stone glyphs of the monoliths gradually gave way to stucco and painted inscriptions on the walls of the temples and to manuscript books.

The age to be ascribed to these remains is purely a matter of conjecture; but there are some historical facts which bear on the subject which I have already called attention to in another publication, but which may with advantage be here repeated.

Hernando Cortes, after the conquest of Mexico, started from that city in the year 1525, accompanied by some hundreds of Spaniards and a large number of Indians, with the intention of marching direct to Honduras. When Señor Don Pascual de Gayangos, in the year 1867, translated for publication by the Hakluyt Society the letter written by Cortes to Philip II. of

Spain, giving an account of this expedition, he states in the preface that:—"To determine the spots visited by him in this extraordinary march through almost impenetrable forests, swampy plains, or lofty mountains, has by some writers been pronounced a hopeless task; and though we possess the narrative of the stout-hearted and sturdy soldier, Bernal Diaz, who formed part of the expedition and carefully noted down its principal events; though the various provinces traversed by the devoted army have since been more or less explored by travellers of all nations, few are the indications—and those very slight—of the route they followed. He must have passed near the ruins of Palenque, since the small village of Las Tres Cruces is said to derive its name from three wooden crosses left in that locality."

A comparison of the recent and more accurate maps of Tabasco published by the Mexican Government, and of my own surveys in the region of the head waters of the Sarstoon and Mopan Rivers, with certain old maps and documents which have recently been brought to light from the Archives of the Indies at Seville, now enables us to trace Cortes's line of march with some degree of accuracy.

After passing the Isthmus of Tehuantepec, he found himself involved in the intricate waterways of the delta of the Tabasco and Grijalra Rivers. He and his followers suffered the greatest hardships, but after cutting their way through the tangled vegetation of the swamps, and with infinite patience and labour building bridges over the almost innumerable streams and lagoons, he crossed the River Usumacinta, somewhere in the neighbourhood of Tenosique.

There can be no doubt that towards the end of this part of this march, at a time when Cortes and his followers, lost in the forests of the delta, were suffering the last extremities of hunger, and were eagerly searching for a track which might lead them to an Indian settlement—they were traversing a plain actually overlooked by the temples of Palenque, and not more, and probably much less, than twenty miles distant from them. If Palenque had then been the great centre which it at one time must have been, and if the foot-hills of the Sierra on which it stands had then been as thickly peopled as the numerous remains indicate, it would have been impossible for a body of men as numerous and as much on the alert as were the followers of Cortes, to have missed the discovery of the many tracks which must have led thither.

Moreover, Cortes had been furnished with a map of the country, prepared by the Indian chiefs at Guacacualco; and although it has been suggested that the chiefs systematically deceived him so as to prevent his visiting their richest and most sacred towns, such deception was not likely to have been successful with him, and it is still less likely to have imposed upon the large number of Mexican Indians who accompanied him. Yet, if Palenque was then inhabited, we are compelled either to believe that Cortes and his followers were indeed successfully imposed upon, or to give credit to the still more unlikely alternative that the Indian auxiliaries preferred to suffer such extremities of hunger that they were driven to eat the bodies of their companions who had died by the way, rather than give any information which would have been of service to their foreign leaders.

It hardly appears possible, therefore, to resist the conclusion that, in the year 1525, Palenque was already abandoned, and lost in the forest.

But if the information afforded to Cortes is to be relied on, then the same fate must also have overtaken the town of Menché on the Usumacinta, for Cortes was strongly advised by the natives not to continue his march along the banks of the river (and if he had done so he must have passed near the site of the ruins of Menché), as the country in that direction was uninhabited.

Accepting this advice, Cortes took the road by Acalá and Peten, and thence through part of what is now British Honduras, to the mouth of the Rio Dulce.

The inhabitants of Acalá appear to have been more civilized than any others whom Cortes met with during his long march. He states that the country was thickly peopled, and that the towns were large and full of mosques or idol-houses, yet no important ruins have ever been found in that district, and neither Cortes nor Bernal Diaz gives us any description which would lead us to suppose that they ever met with such imposing buildings as those still standing at Palenque or Menché.

From Acalá the expedition marched through a very thinly-peopled country until they arrived at the Lake of Peten.

Cortes visited the town of Tayasal, built on a small island in the lake, which, we are told, was the chief town of the district, and which was doubtless then, as it was later, the stronghold of the warlike Itzaes. Now, fortunately, we know something of the subsequent history of this town, for Tayasal was visited by missionaries from Yucatan in 1618, 1619, and 1623. This last missionary expedition ended disastrously, as the missionary and his followers were murdered by the natives; and we then have but scanty information about the Itzaes until the country was invaded by the Spaniards from Yucatan, and Tayasal captured in 1697. A curious story shows us that Tayasal is not likely to have suffered any serious disturbance between Cortes's visit and the year 1618.

In his letter to the King he states that, "At this village, or, rather, at the plantations that were close to the lake, I was obliged to leave one of my horses, owing to his having got a splinter in his foot. The Chief promised to take care of the animal and cure him, but I do not know if he will succeed, or what he will do with him."

On the day after the arrival of the missionary fathers Fuenzalida and Orbita, in 1618, the Chief of the Itzaes showed them round the town, "in the middle of which, on the rising ground, were numerous and large buildings, 'cues' or oratories of their devilish and false gods. Entering into one of them, they saw in the centre of it a large idol in the form of a horse, well modelled in stone and plaster. It was seated on the ground, on its haunches.

"These barbarians revered it as the God of Thunder, and called it Tzimindiac, which means 'the horse of thunder and lightning.'"

This sight was too much for the religious zeal of Padre Orbita, who, seizing a great stone, jumped on to the idol and hammered it to pieces. It is hardly necessary to add that the Chief had the greatest difficulty in saving the lives of the missionaries from his infuriated people, and that they were compelled to leave the island at once.

It was afterwards learnt from the natives that they had thought the horse to be the god of thunder and lightning because they had seen the Spaniards firing their guns from horseback, and that when they found the horse to be ill, "they gave it to eat fowls and other meat, and presented it with garlands of flowers, as it was their custom to do when their own chiefs were ailing," and that, on its death, a council of chieftains was called, and it resolved to make an image of the horse in stone.

In the year 1700, the historian Villagutierrez published a detailed account of the conquest of Itza by the Spaniards, and a description of the town of Tayasal, stating that "it was full of houses, some with stone walls more than a yard high, and, above these, wooden beams and roofs of thatch, and others of wood and thatch only"; and "of the twenty-one oratories which General Ursua found in the island, the principal and largest was that of the high priest Quincanek, cousin of the king Canek; this was rectangular (*cuaadrada*), with a beautiful breastwork (*pretil*) and nine handsome steps, and each front was about twenty yards long and very high."

Speaking from memory, I should say that the island is not more than 500 yards across, and there are no signs whatever at the present time of any ancient foundations. It is now covered with poorly-built adobe houses, and in the centre is a church, which probably occupies the site of the ancient 'cues.' Now, within a day's walk from the north shore of the lake are the very remarkable ruins of Tikal, of which a short description has already been given; yet nothing whatever is told us either by Cortes, by the missionaries, or by Villagutierrez, of the existence of a town on this site, and the ruins were unknown to the Spaniards until the year 1848.

The missionaries, on their journeys from the Spanish outpost at Tipu to Tayasal must have passed within a few miles of the site of the ruins; and it is impossible to believe that, so long as Tikal was inhabited, Tayasal could have been the chief town of the district, or, indeed, that Tikal could have been inhabited at all without the fact coming to the knowledge of the Spaniards.

If any further evidence were needed to show that the great structures raised during the epoch of higher civilization had already been deserted at the time of the Spanish conquest, it can be found in what Cortes himself states with regard to the town in Guatemala which he calls Chacujal.

When, after having crossed the base of the peninsula of Yucatan, the starving army arrived at the mouth of the Rio

Dulce, it was only to find the Spanish colony it had come in search of reduced to a similar extremity of famine.

The scanty Indian population in the neighbourhood had been rendered hostile by the exactions of the settlers, and it was immediately necessary to scour the country for long distances in search of food. The most important of these raids, and, indeed, the only successful one, was led by Cortes himself, who landed on the south side of the Golfo Dulce, and marched about two leagues inland (when he must have been within about twelve to fifteen miles of the site of the ruins of Quirigua), and then turned along the mountain-range to the south of the Rio Polochic, and finally succeeded in reaching Chacujal, which is situated between two small streams which run into the Polochic. The inhabitants had all fled, but Cortes was fortunate in finding a large store of Indian corn, and other food.

Cortes writes of the town as follows:—"Marching through the place we arrived at the great square, where they had their mosques and houses of worship, and as we saw the mosques and buildings round them just in the manner and form of those at Culua" (on the coast of Mexico), "we were more overawed and astonished than we had been hitherto, since nowhere since we had left Acalá had we seen such signs of policy and power. . . . On the following morning I sent out several parties of men to explore the village, which was well designed, the houses well built, and close to each other." I can find no record whatever of Chacujal subsequent to the date of Cortes's visit; but in 1884 I myself visited the ruins of the town, guided by Cortes's own description of the site. The ruins are now completely buried in the forest, but there was little difficulty in tracing the general plan of the town, and making out the foundations of the principal buildings.

It is easy to understand how Cortes may have been favourably impressed with the flourishing appearance of the place after his terrible and tedious journey through the forest, yet it is quite clear from the ruins that the structures themselves could never have been of any considerable importance. The walls of the principal buildings had only been built of stone to half their height, and the superstructure and roof must have been made of some perishable material—a great contrast to the thick stone walls and heavy stone roofs at Palenque, Tikal, Menché, and Copan. Another point of importance is that the plan and method of construction of the buildings at Chacujal is similar to that of the ruins on the hill-tops a little further inland near San Jeronimo, Rabinal, and Cubulco, some of which I have visited. These were undoubtedly the strongholds of those Indians of the Tierra de Guerra to whom no high culture has ever been attributed, and who were induced by the Padre Las Casas to leave their fastnesses and settle in the plain of Rabinal in the year 1537.

It can therefore now be stated without doubt that, although Cortes and his followers on his march from Mexico to Honduras passed within a short distance of several of the sites of the most important ruins in Central America, they heard nothing of their existence as living cities.

Let us now consider the case of the often-described ruins of Copan on the northern frontier of Honduras.

The earliest information dates back to the year 1576, when the ruins were visited by Palacio del Rio, who described them in a letter written to King Philip II. of Spain. After giving an account of the sculptured monoliths, he mentions the numerous mounds which could be ascended by stone stairways, but he says nothing whatever about houses or temples, which such a careful observer as Palacio could not have omitted to mention had they then been in existence. He further states in his letter that it was impossible to believe that the scanty Indian population of the districts could have raised such monuments as he found at Copan, and that his efforts to elicit information from the leaders of the Indians dwelling in the neighbourhood only showed that all knowledge of the people who had raised these monuments was lost in the mists of tradition.

Enough has now been said to show that the most important ruins in the whole of this Maya district (outside of Yucatan) were never known to the Spaniards as the sites of inhabited towns, and it now remains to say only a few more words about those towns in which the conquerors actually found the people dwelling. The descriptions already quoted from early writers, or given from my own observations of the ruins in the cases of Tayasal and Chacujal, give some idea of what these towns were like; and the correctness of these descriptions is strengthened by the results of a careful examination which I have made of the sites

of the towns of Utatlan and Iximché, the capitals of the Quichés and Cachiuels, who were the most powerful tribes in Guatemala when Alvarado conquered the country. Although the remains of these towns, which were known for certain to have been inhabited at the time of the Spanish conquest, bear some similarity in plan and arrangement to the older ruins, there is the great distinction to be observed that in no instance is there any indication of the former existence of stone-roofed buildings, that there are only a few stones which show any trace of ornamental carving, and that of the roughest description, and that there are no remains of any carved inscriptions.

It may be as well to say a word of warning against the exaggerated accounts of the magnificence of the Indian towns of Guatemala at the time of the conquest which have found their way into the histories of the country by Fuentes, Juarros, and others, and are still alluded to and sometimes accepted as facts by modern travellers. To give only one instance. In describing the palace of the Quiché kings at Utatlan, dimensions are given for this palace which exceed the whole extent of the land on which any building is possible, for the site of the town is most clearly defined, and limited by the great "barranca" or rift, some hundreds of feet deep, which almost encircles it. It was no doubt this peculiar situation, that of an almost inaccessible peninsula in the middle of an undulating plain, which gave the site so much value in the eyes of the Quichés.

There is, then, a clearly marked difference between the remains of the towns of which we have some historical knowledge and the more ancient ruins.

But when one considers the fair state of preservation of some of the buildings at Palenque and Menché, and the presence of sound wooden beams in the temples and houses at Tikal, it is hardly possible to ascribe even to these ruins any very great antiquity.

From my own observation of the state of the ruins themselves, and the style of art displayed in the carved ornaments and inscriptions, I should feel inclined to give to Quirigua the earliest date, Copan the next, then Menché, Palenque, and Tikal, in the order named.

We must now turn our attention to the province of Yucatan.

The central portion of the peninsula has always been more or less a *terra incognita*. The Spaniards never really brought its inhabitants into complete subjection, and to this day it is peopled by hostile Indians, and no Spaniard dares to enter it.

If this country contains traces of the old civilization, nothing definite is known of them. The northern portion of the peninsula was brought completely under Spanish control, and is known to be studded with the remains of groups of ancient stone buildings.

It was on the north-east coast of Yucatan that the Spaniards first came into contact with Indians who used stone as a building material, and there can be but little doubt that some of the many ruined structures now to be seen were inhabited by the natives at the time of the conquest.

I am myself inclined to the opinion that the north of Yucatan was the last stronghold of the more cultivated branch of the Maya race after that race had either been driven out of, or under the stress of unknown adverse circumstances had retrograded in, the country to the south. But it does not follow that the Indians of Yucatan were at the height of their power and prosperity when the Spaniards came amongst them. In fact, their conquerors learnt from them that for some time previously the country had been troubled with civil wars and dissensions, and that Mayapan, once the chief town, had been destroyed and abandoned. It seems quite probable that this statement may be enlarged on to a considerable extent, and that we may consider the country to have been in a state of decadence, and that not one but many of the chief centres of population had been more or less abandoned. However, the temples and sacred edifices appear still to have been held in reverence after the population had moved away, and were visited during festivals, and may have been kept in some sort of repair by the priests; much in the same way as I believe the ruined dagobas and temples at Pollonaruwa and Anuradhapura are revered and visited by the people of Ceylon.

This appears to me to have been most probably the case with regard to the important buildings which still mark the site of what must have once been the large town of Chichén Itzá.

It has, I know, been stated that Chichén was inhabited at the time of Francisco de Montejo's first abortive effort to conquer Yucatan, and that the Spaniards were for some considerable time encamped in the town; but this statement does not appear

to me to be supported by any sufficient evidence. Nevertheless, religious ceremonies had been so recently observed in Chichén Itzá, that, in answer to a despatch from Spain, a committee of the settlers in the neighbouring town of Valladolid were able to give some account of them in the year 1579.

My personal experience of the ruins in Yucatan is limited to a hasty visit to Labna and Uxmal, and a residence of five months in one of the ruined temples of Chichén Itzá. At Chichén my clearings and surveys extended over an area of nearly a mile square, and although this appeared to include all the principal edifices, it was impossible to walk into the bush in any direction from the edge of this area without coming on the traces of stone buildings.

The surface of the ground, even in the centre of the town, although generally level, was in some places composed of cavernous and broken limestone rock, and these portions had apparently been walled off as unfit for buildings. But, wherever the ground was suitable, there were numerous traces of slightly constructed buildings in addition to the more solid structures.

The hieroglyphic inscriptions at Chichén are few in number, and with one small exception very poorly carved, but there is enough to show that they did not differ in character from those in Guatemala and Chiapas. There is, however, one great distinction between the sculptures in Yucatan and the country to the south which must not be overlooked. In the latter there is an almost entire absence of weapons of war, and the figures of women occupy a prominent position. In Yucatan the change is complete: there are no women represented in the sculptures, and every man is a warrior armed with spears and throwing-stick.

Whether the Maya civilization extended to Yucatan during the time that it flourished at Copan or Palenque, it is at present impossible to determine; but I strongly incline to the opinion that all the buildings now standing in Yucatan are of a later date. It may be perhaps allowable to state the case somewhat as follows:—

That the civilized portion of the Maya race have at some time occupied all the country lying between the Isthmus of Tehuantepec and the western frontiers of Honduras and Salvador (excepting perhaps a strip of country along the Pacific sea-board); that this people spoke the same or nearly allied languages, which they wrote or carved in the same script; that they were followers of the same religion, and built stone-roofed temples and houses decorated with the same class of design and ornament.

That at the time of the Spanish conquest they had entirely abandoned all their towns and religious centres in the country to the south of Yucatan, although the good state of preservation of many of the buildings at the present time precludes the idea that this desertion of their towns could have ante-dated the arrival of the Spaniards by very many years. That the people whom the Spaniards encountered in this part of the country, although they may have been allied in blood to the Mayas, were undoubtedly in a lower state of culture, and that an examination of the sites of their principal towns yields no signs of the artistic culture which is universally found in the older ruins.

That in Yucatan, where the Spaniards found a dense population of Maya Indians, and encountered a fierce and stubborn resistance, there are still to be seen numerous remains of ancient buildings, both larger and in better preservation than those in Guatemala and Chiapas, but built in the same manner, decorated with the same ornaments, and with inscriptions carved in the same hieroglyphic script. That there is evidence, from the early Spanish writings, that some at least of those buildings were still occupied at the time of the conquest; but that both the observations of the Spaniards themselves, as well as the reports subsequently gathered by them from the Indians, point to the conclusion that the country was in a state of decadence, and that many of the larger centres of population had already been abandoned, although the more important religious edifices may still have been revered and kept in repair.

The early Spanish writers make frequent allusion to the large number of books written and preserved by the natives of Yucatan. These books were written in hieroglyphic characters in the Maya language, which, it must be remembered, is still spoken by the whole of the Indian population of Yucatan, as well as by nearly all the half-breeds and Spaniards.

Unfortunately, every effort was made by the Spanish priests to destroy this literature, which they looked on as the work of the devil; and it is very doubtful whether a single fragment of hieroglyphic manuscript is now in existence in the whole peninsula.

One of the chief of the iconoclasts was Archbishop Diego de Landa; but, luckily, his zeal was tempered by a considerable appreciation of the ingenuity of the Indians, and an interest in their manners and customs, which induced him to make some notes on their method of writing and recording events.

It is to this that we owe what is commonly known as "Landa's alphabet"; but, as this was an attempt to make an alphabet of a language which in all probability was not written alphabetically but syllabically, it was a signal failure, and has proved, to the few scholars who have attempted to employ it, about as puzzling as the hieroglyphics themselves. However, it may ultimately be of some use, and it was accompanied by an explanation of the calendar system, and a list of the signs for the days and months, with their names, which is of the greatest value.

Although no Maya books are known to exist in America, three examples of what are undoubtedly genuine Maya manuscripts have turned up in Europe.

No information whatever is forthcoming as to how they got here, but it is not unlikely that they were sent over as curiosities at the time of the Spanish conquest, and were afterwards lost sight of.

They are the "Codex Troano," now preserved in the Archaeological Museum at Madrid, a chromolithographic copy of which was published by the Abbé Brasseur de Bourbourg; the "Dresden Codex," preserved in the Royal Library at Dresden, of which a beautiful photolithographic copy has been published under the direction of Prof. Försteman; and the "Codex Peresianus," in the Bibliothèque Nationale at Paris. Another manuscript at Madrid, which has been called the "Codex Cortesianus," appears to be only a detached portion of the "Codex Troano."

An examination which I have made of the two first-mentioned Codices leaves no doubt on my mind about the similarity of the written to the carved inscriptions. Many of the glyphs are identical, and others only vary as much as might be expected by the change from carving on stone to writing on paper. In addition to this evidence of the eyes, there is the distinct statement of Cogolludo, the historian of Yucatan, that the Indians had "characters by which they could understand one another in writing, such as those yet seen in great numbers on the ruins of their buildings."

So that we arrive at the important conclusion that the language of the carved inscriptions of Copan, Quirigua, and Palenque is still a living tongue, although it has doubtless been much changed in the course of years.

ALFRED P. MAUDSLAY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. C. E. Ashford, B.A. of Trinity College, has been appointed Assistant Demonstrator of Physics in the Cavendish Laboratory.

Dr. William Ewart and Mr. Frederick Treves have been appointed additional examiners in Medicine and Surgery respectively.

The Cavendish Professor announces a course of lectures on Electrolysis and Solution, to be given by Mr. W. C. D. Whetham on Thursdays and Saturdays during the present term.

Seventeen candidates were approved for the diploma in Public Health at the extra examination held at the beginning of the month.

T. Clifford Allbutt, M.D., F.R.S., the newly appointed Regius Professor of Physic, has been elected to a Fellowship at Gonville and Caius College.

The Shuttleworth Scholarship in Botany has been awarded to I. H. Burkill, B.A., Assistant Curator of the Herbarium.

The memorial in Westminster Abbey to the late Prof. J. C. Adams, will be placed in the sill of the window on the north side, nearest to the monument of Newton. A large and very influential committee has been formed for the purpose of establishing the memorial.

SCIENTIFIC SERIALS.

American Journal of Science, March.—Mount St. Elias and its glaciers, by Israel C. Russell. Account is given of the country explored by two parties sent to Alaska by the National Geographic Survey, in connection with the U.S. Geological

Survey, in 1890 and 1891.—Hudson River "Fiord," by Dr. Arthur M. Edwards.—Contributions to mineralogy, No. 52, by F. A. Genth; with crystallographic notes by Samuel L. Penfield. The minerals described are hübnerite, hessite, bismutite, and natrolite.—Tschermak's theory of the chlorite group and its alternative, by F. W. Clarke.—Recent fossils near Boston, by Warren Upham. Fossil marine shells of the post-Glacial epoch have been lately discovered near Boston, indicating slight recent changes in the relative levels of land and sea, and proving considerable changes in the temperature of the sea there.—The highest old shore line on Mackinac Island, by F. B. Taylor.—On the nature of colloid solutions, by C. E. Linebarger. It is generally believed that solutions of colloid substances, such as albumen or silicic acid, differ in their nature from solutions of crystalline substances. The author's experiments indicate that colloid solutions are solutions in the ordinary acceptance of the term, and not "suspensions."—Observations upon the structural relations of the Upper Huronian, Lower Huronian, and Basement Complex on the north shore of Lake Huron, by Raphael Pumpelly and C. R. Van Hise.—A phasemeter, by John Trowbridge. The phasemeter is an instrument devised for the investigation of questions of the phase of alternating electric currents in transformers and in branch circuits. Two telephone diaphragms have mirrors fixed upon them. A spot of light reflected from one of the mirrors is given a horizontal movement when the diaphragm is vibrating, while the other mirror, when its diaphragm moves, gives a spot of light a vertical motion. By the combination of the two motions, figures are obtained similar to those of Lissajous in the case of tuning-forks; and from these, the difference in phase of the currents which set the diaphragms in motion can be found.—Preliminary report of observations at the Deep Well, Wheeling, West Virginia, by William Hallock.—Mount Bob, Mount Ida, or Snake Hill, by T. W. Harris.

April.—On the action of vacuum discharge streamers upon each other, by Dr. M. I. Pupin. The experiments described show that two electric current filaments in a rarefied gas may repel each other in cases where electrodynamic action would produce an attraction. The repulsion does not appear to be due to electrostatic action, but rather to "a strain in the vacuum produced by the peculiar distribution of the gas pressure resulting from the peculiar distribution of temperature."—On a melilite-bearing rock (Alnoite) from Ste. Anne de Bellevue, near Montreal, Canada, by Frank D. Adams.—On an azure-blue pyroxenic rock from the Middle Gila, New Mexico, by George P. Merrill and R. L. Packard.—On the correlation of moraines with raised beaches of Lake Erie, by Frank Leverett.—Magnesium as a source of light, by Frederick J. Rogers. The results of this investigation are summed up as follow:—(1) The spectrum of burning magnesium approaches much more nearly that of sunlight than does the spectrum of any other artificial illuminant. (2) The temperature of the magnesium flame, about 1340° C., lies between that of the Bunsen burner and that of the air-blast lamp, although the character of its spectrum is such as would correspond to a temperature of nearly 5000° C. were its light due to ordinary incandescence. (3) The "radiant efficiency" is 13½ per cent., a value higher than that for any other artificial illuminant, excepting, perhaps, the light of the electric discharge *in vacuo* for which Dr. Staub, of Zürich, has found an efficiency of about 34 per cent. (4) The radiant energy emitted by burning magnesium is about 4630 calories per gram of the metal burned, or 75 per cent. of the total heat of combustion, as compared with 15 per cent. to 20 per cent. in the case of illuminating gas. (5) The thermal equivalent of one candle-power-minute of magnesium light is about 2.4 lesser calories, as against 3.5 to 4.0 for other artificial illuminants. (6) The total efficiency of the magnesium light is about 10 per cent., as compared with 0.25 per cent. for illuminating gas. (7) Taking into consideration the greater average luminosity of the rays of the visible spectrum of the magnesium flame, it is certain that *per unit of energy expended, the light-giving power of burning magnesium is from fifty to sixty times greater than that of gas.*—A method for the quantitative separation of barium from calcium by the action of amyl alcohol on the nitrates by P. E. Browning.—On plicated cleavage foliation, by T. Nelson Dale.—Geological age of the Saganaga syenite, by A. R. C. Selwyn.—A third occurrence of peridotite in Central New York, by C. H. Smith.—A fulgurite from Waterville, Maine, by W. S. Bayley.—Mineralogical notes on brookite, octahedrite, quartz, and ruby, by G. F. Kunz.—Recent polydactyle horses, by O. C. Marsh.